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ABSTRACT

This report itemizes the costs and consequences of sedentary living, providing cost reasons to fight a war on sedentary lifestyles. It begins by explaining that 70 percent of U.S. adults are sedentary (undertaking no leisure time physical activity or less than 30 minutes of physical activity per day), and it notes how sedentary living increases the risk of many chronic conditions. Next, it defines chronic disease and presents data on all chronic health conditions combined and on several specific chronic health conditions (coronary heart disease, type 2 diabetes, obesity, obesity-related disorders, and the aging population). It goes on to examine the costs of sedentary living, including mortality costs and economic costs for all chronic health conditions and for sedentary disorders. After asserting that the war on chronic health conditions is not being won, it explains the need to be proactive rather than reactive and to promote primary prevention. Finally, it discusses weapons to combat sedentary induced disease (e.g., focusing on cost benefits, promoting advocacy and activism among professionals associated with physical activity in their occupations, and disseminating information to the general public). (Contains 37 references.) (SM)

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Research Digest
Cost and Consequences of Sedentary Living:
New Battleground for an Old Enemy

President's Council on Physical Fitness and Sports
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Cost and Consequences of Sedentary Living: New Battleground for an Old Enemy

Introduction

In a recent review in the *Journal of Applied Physiology* (Booth et al., 2000) we opened with the statement: "OUR SOCIETY IS AT WAR. Although it may not be commonly publicized in this manner, make no mistake, our society, and even the world's population in general, is truly at war against a common enemy. That enemy is **modern chronic disease**." As this statement was published (February 2000) before the tragic events on September 11, 2001, many will initially think of "terrorism" as the war when they begin reading the first part of the above statement. However, there are now multiple wars being fought, with some wars getting more attention from the media, government and public interest than others. The purpose of this review is to update our earlier review by itemizing, as best we can, the costs and consequences of sedentary living, and thus provide cost reasons to fight a war against sedentary lifestyles.

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The silent enemy: sedentary living

Our definition of sedentary living is based upon the recommendation of the Expert Panel of the CDC and the American College of Sports Medicine (ACSM), who recommended: "Every American should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week . . . adults who engage in moderate-intensity physical activity—i.e., enough to expend 200 calories per day—can expect many of the health benefits described herein . . . one way to meet this standard is to walk 2 miles briskly . . . most adults do not currently meet the standard described herein . . ." (Pate et al., 1995). We propose that sedentary is the level of physical inactivity below which the threshold for initial health effects occur. Those who don't walk briskly at least 30 minutes each day are sitting too much of the day. Other investigators have reported that <30 min/day of moderate-intensity physical activity in the large population nurses' health studies increased their risk of coronary artery disease, stroke, or type 2 diabetes by 43% as compared to those women who walked ≥ 30 min each day (Hu et al., 1999; Hu et al., 2000; Manson et al., 1999). Our definition of sedentary therefore includes those who undertake no leisure-time physical activity (28% of US adults) and those who undertake < 30 minutes of physical activity each day (42% of US adults). Thus, by our health threshold definition, ~70% of US adults are sedentary.

Numerous consensus statements document that sedentary living increases the risk of many chronic health conditions. Three examples are given:

- 1995: A combined recommendation from the CDC/ACSM stated: "Epidemiologic research has demonstrated protective effects of varying strength between physical activity and risk for several chronic diseases, including coronary heart disease, hypertension, non-insulin-dependent diabetes mellitus, osteoporosis, colon cancer, and anxiety and depression." (Pate et al., 1995).
- 1996: The Surgeon General's Report on *Physical Activity and Health* wrote: "Physical activity of the type that improves cardiovascular endurance reduces the risk of developing or dying from cardiovascular disease, hypertension, colon

cancer, and type 2 diabetes and improves mental health. Findings are suggestive that endurance-type physical activity may reduce the risk of developing obesity, osteoporosis, and depression and may improve psychological well-being and quality of life. There is promising evidence that muscle strengthening (resistance) exercise reduces the risk of falling and fractures among the elderly (Surgeon General, 1996)."

- 2001: The consensus statement from the Dose-Response Issues Concerning Physical Health: An Evidence-based Symposium stated: "Regular physical activity is associated with a reduction in all-cause mortality, fatal and nonfatal total cardiovascular disease, and coronary heart disease. It is also associated with a reduction in the incidence of obesity and type 2 diabetes mellitus, and improvement in the metabolic control of individuals with established type 2 diabetes. Furthermore, physical activity is associated with a reduction in the incidence of colon cancer and osteoporosis. Further benefits of regular physical activity include improved physical function and independent living in the elderly. Individuals with high levels of physical activity are less likely than those with lower levels to develop depressive illness." (Kesaniemi et al., 2001). Thus, it is clear from multiple consensus statements that sedentary lifestyle increases the risk of chronic health conditions. A comprehensive listing of those health conditions whose risk is increased by sedentary living is given in Table 1.

Table 1: Conditions that are caused or worsened by sedentary lifestyle.

Sedentary living increases these conditions.	Sedentary living increases the progression of these conditions.
Angina, heart attack, coronary artery disease	Chemotherapy
Breast cancer	Chronic back pain
Colon cancer	Debilitating illness
Congestive heart failure	Disease cachexia
Depression	Falls resulting in broken hips
Gallstone disease	Physical frailty
High blood triglyceride	Spinal cord injury
High blood cholesterol	Stroke
Hypertension	Vertebral/femoral fractures
Less cognitive function	
Low blood HDL	
Lower quality of life	
Obesity (more difficult time with weight control)	
Osteoporosis	
Pancreatic cancer	
Peripheral vascular disease	
Physical frailty	
Premature mortality	
Prostate cancer	
Sleep apnea	
Stiff joints	
Stroke	
Type 2 diabetes	

Therefore, given these facts, we have coined the phrase: **Sedentary Death Syndrome (SeDS)** to categorize the emerging entity of sedentary lifestyle-mediated disorders that ultimately result in increased mortality. We believe this term is appropriate to describe the nature of the war we are fighting, considering that the word "syndrome" is from the Greek word "syndromē," which means "running together." Currently, a syndrome is defined as "a group of symptoms that together are characteristic of a specific disorder, disease, or the like" (Random House, 1997), where disease is defined as an interruption, cessation, or disorder of body function, system, or organ (Stedman's, 2000). Weak skeletal muscles, low bone density, hyperglycemia, glucosuria, low serum HDL, obesity, low physical endurance, and resting tachycardia are a set or group of symptoms that together characterize SeDS.

Casualties of war

Before embarking on delineating the toll modern chronic diseases inflict upon our citizens, it is necessary to define what is meant by "chronic disease. This is a condition that is slow in its progress and long in its continuance (Dorland's, 1974). In contrast, "acute disease is a condition characterized by a swift onset and short course" (Dorland's, 1974). Thus, the incubation period for a chronic disease, such as type 2 diabetes, is years and is generally incurable, while an acute disease, such as a common cold, has an incubation period of merely days and its clinical course is usually completed within weeks. Chronic health condition is a general term that includes both chronic diseases and impairments (Hoffman, Rice, and Sung, 1996).

Casualties for all chronic health conditions combined.

Approximately 90 million US inhabitants had one or more chronic health conditions in 1987 (88.5 million of those were in non-institutionalized settings and 1.5 million people lived in nursing or personal care homes) (Hoffman, Rice, & Sung, 1996). About 32.2 million of these people had activity limitations associated with their chronic health conditions (Hoffman, Rice, & Sung, 1996). Of these, 9.2 million were unable to perform their major activity, as appropriate for their age. Rates of chronic conditions varied with age and were highest among the elderly, with frequencies of having at least one chronic condition being: 88% in elderly (>65 years), 68% in 45-64-year-olds, 35% in 18-44-year-olds, and 25% in 18 years and younger. However, due to the absolute size of each of these age groups, adults 18 to 64 years old accounted for 60% of all non-institutionalized persons with chronic conditions.

Another category of chronic condition is often referred to as comorbidity. The term comorbidity is defined as "a concomitant but unrelated pathologic or disease process, usually used in epidemiology to indicate the coexistence of two or more disease processes" (Stedman's, 2000). One in six children with chronic conditions (17%) had a

comorbidity (Hoffman, Rice, & Sung, 1996). Compared with those with only one chronic condition, these children were more likely to be limited in their activity, experienced more days spent in bed, and had more absences from school (Hoffman, Rice, & Sung, 1996).

Casualties by specific chronic health conditions.

Coronary heart disease. Coronary heart disease has been the number one cause of death in the United States in the 20th century for every year but one (1918) (American Heart Association, 1998). Cardiovascular disease was the primary cause of 949,619 deaths (41% of all deaths) in 1998 and was the primary or contributing cause of 1.4 million deaths (60% of all deaths) (American Heart Association, 2000). Cardiovascular disease claims more lives each year than the next seven prevalent causes of death combined (American Heart Association, 1998). The American Heart Association stated that the number of people dying from diseases of the heart has risen by 37% (200,000 additional yearly deaths) from 1950 to 1996 (American Heart Association, 1998), while the total US population increased by 43%. Although annual death rates from cardiovascular disease have just recently begun to decline (21.3% from 1986 to 1996), the absolute number of cardiovascular deaths declined only 2% in the same 10-year period (American Heart Association, 1998).

Type 2 diabetes. The increase in type 2 diabetes is being called an epidemic (Mokdad et al., 2001). The CDC concluded: "Interventions are needed to improve physical activity and diet in communities nationwide" (Mokdad et al., 2001). A five-fold increase in prevalence of Type 2 diabetes occurred between 1958 and 1993 (Harris & Eastman, 2000). According to the American Diabetes Association, more than 400,000 people with diabetes die each year, half of them just because of diabetes (American Diabetes Association, 2001). This number is sure to rise for the following reasons. Older textbooks of internal medicine consider type 2 diabetes as a disease rarely seen under the age of 40 years. Recently, Pinhas-Hamiel et al. (1996) noted a 10-fold increase in type 2 diabetes between 1982 and 1994 in adolescents in one Cincinnati hospital. Thus the overall increase in type 2 diabetes is not solely a result of the fact that the mean age of the US population is now growing older (Libman & Arslanian, 1999). The consequences of this demographic switch are not good. Onset of type 2 diabetes at an early age makes these individuals susceptible to developing diabetes-associated comorbidities such as blindness, end-stage renal disease, amputations, heart disease, and strokes much earlier in life. A recent publication predicts that the number of Americans with diagnosed diabetes is projected to increase 165%, from 11 million in 2000 (prevalence of 4.0%) to 29 million in 2050 (prevalence of 7.2%) (Boyle et al., 2001). The largest percent increase in diagnosed diabetes will be among those aged 75 years (+271% in women and +437% in men). Type 2 diabetes is also more prevalent in specific ethnicities. The fastest growing ethnic group with diagnosed diabetes is expected to be black males (+363% from 2000-2050), with black females (+217%), white males (+148%), and white females (+107%) (Boyle et al., 2001). Of the projected 18 million increase in the number of cases of diabetes in 2050, 37% are due to changes in demographic composition, 27% are due to population growth, and 36% are due to increasing prevalence rates (Boyle et al., 2001). The need to administer medical treatment because of these projected increases will likely increase the economic strain on their families and society.

Obesity. The current trend in obesity statistics has also become epidemic (Mokdad et al., 2001). Obesity was estimated to annually account for 280,000-325,000 deaths in the US using 1991 statistics (Allison et al., 1999), and this number is likely growing. The CDC documented the prevalence of obesity in 2000 as being 19.8% among US adults, reflecting a 61% increase since 1991 (Mokdad et al., 2001). In the year 2000, a total of 38.8 million US adults were obese (19.6 million men and 19.2 million women), and approximately 2.1% (1.5% of men and 2.8% of women) of all participants had morbid obesity (BMI $\geq$ 40 kg/m^2), compared with 0.9% in 1991 (Mokdad et al., 2001). Also, the percentage of overweight adults (BMI $\geq$ 25 kg/m^2) increased to 56.4% in 2000, compared with 45% in 1991 (Mokdad et al., 2001). Indeed, the average rate of rise in obesity in the last 10 years accelerated to 6.1% per year, compared to a 2.2% per year increase that was noted in the 1960-1994 period (Flegal, et al., 1998).

Like adults, the number of overweight children and adolescents in the US also increased between the 1960-1962 period and the 1988-1994 period, with this rate of increase also accelerating in the final 10-12 years of this interval (Flegal et al., 1998). Approximately 11% of US children and adolescents were reportedly overweight in the 1988-1994 period (Troiano & Flegal, 1998). Moreover, the 90% increase in proportion of obese persons in the 18- to 29-year-old age group from 1991 (with a 7.1% prevalence of obesity) to 2000 (with a 13.5% prevalence) (Mokdad et al., 1999; Mokdad, 2001) indicates that those statistics in children are now translating into similar trends within the young adult population of the US. The obesity epidemic is therefore like the type 2 diabetes epidemic in that its advance is not just a sole function of more individuals reaching middle age in the US population. Rather, these statistics indicate that for many individuals these are problems originating in the lifestyles of children and adolescents. Children now exhibit some risk factors for chronic health conditions. Sixty percent of overweight 5- to 10-year-old children already have one biochemical or clinical cardiovascular risk factor, such as hyperlipidemia, elevated blood pressure, or increased insulin levels, and 25% have 2 or more (Koplan & Dietz, 1999).

Obesity-related disorders. Obesity is a comorbidity of some of the most prevalent diseases of modern civilization (Jung, 1997; Must et al., 1999). The prevalence of comorbidities rises with increasing body mass index (BMI) (Must et al., 1999). For example, BMI's > 35 kg/m^2 are associated with a 93-fold and 42-fold increased risk of Type 2 diabetes in

women and men, respectively. The risk of coronary heart disease is increased 86% by a 20% rise in body weight in men, whereas this risk is increased 3.6-fold in obese women (Jung, 1997). A higher prevalence of diseases such as hypertension, osteoarthritis, and gallbladder disease is also associated with increasing obesity (Must et al., 1999).

Aging population. The average age of the US population is getting older. Currently, 3.5 million US citizens are 85 years or older. This number will increase as there will be a substantial increase in the relative size of the elderly population after the year 2011 when the oldest members of the baby-boom cohort (people born in 1946) reach the age of 65. The Census Bureau projects that, by the year 2040, there will be at least 8-13 million Americans 85 years of age or older (Campion, 1994). A quarter of all women and 15% of all men aged 84 years or older lived in nursing homes in the 1990s (Campion, 1994). Most chronic diseases are also considered age-related diseases, since they clinically manifest themselves to a greater degree later in life (Must et al., 1999). Thus, it is logical to expect the prevalence of modern chronic disorders to rise in future years due to: 1) the progressive aging of the US population and 2) the increasing prevalence of chronic disorders noted in younger age groups. Our health care system is headed for trouble unless we soon find a way to implement better preventive measures against the progression of chronic diseases.

Costs of sedentary living

"Cost" is defined as the "the price paid to acquire, produce, accomplish, or maintain anything" (Random House, 1997). In this review, we will consider "cost" as both money and the non-money effort required to acquire, produce, accomplish, and maintain quality of life, well-being, and health.

Economic costs:

For all chronic health conditions: Chronic health conditions compose the major health cost according to the following data from Hoffman et al. (1996). While 46% of people reported chronic conditions in 1987, they accounted for 76% of the direct medical care costs in the United States. The direct costs of health services and supplies for non-institutionalized people with chronic conditions totaled $272.2 billion in 1987. Annual health care costs for people with chronic conditions, which included care for both their chronic condition and any acute health problems they may have experienced, averaged $3074 in 1987 compared with $817 for persons with only acute conditions. People with more than one chronic condition spent $4672 per year on health care in 1987 compared with $1829 for people with only one chronic condition. The indirect costs of chronic health conditions are also staggering. The loss to the economy amounted to $161.3 billion or an average of $98,304 per death. Mortality costs combined with morbidity costs amounted to $234 billion in total indirect costs due to chronic conditions in 1990.

In addition, individuals with chronic health conditions accounted for disproportionately large utilization, and hence, cost of health care resources, both in services and supplies. Almost 96% of home care visits, 83% of prescription drug use, 66% of physician visits, and 55% of emergency department visits were made by people with chronic health conditions, and they represented 69% of hospital admissions, requiring longer hospital stays (7.8 days), compared to persons without chronic health conditions (4.3 days) (Hoffman, Rice, & Sung, 1996). It would be logical to target the largest health care expense if attempts are made to reduce health care costs.

For sedentary disorders: The direct and indirect costs of sedentary lifestyle to chronic health conditions were reported to be in excess of $150 billion (cost in 2000 dollars for 1987 incidences) (Pratt, Macera & Wang, 2000). As health care costs are $1.3 trillion/year in the US, a rough approximation is that physical inactivity accounts for approximately 15% of the US health care budget. A simple calculation confirms this report. The costs of cardiovascular disease ($298.2 billion in the year 2001; American Heart Association) and type 2 diabetes ($98 billion, American Diabetes Association) combine to $396 billion/year. A 30% reduction in these two disorders would save the US economy $119 billion. Such a reduction is feasible because a 30% reduction in the occurrence of coronary artery disease, stroke, and type 2 diabetes was achieved in those who undertook a minimum of 2.5 hours of brisk walking per week as compared to the sedentary group, based on the results of the large population nurses' health studies (Hu et al., 1999; Hu et al., 2000; Manson et al., 1999). Costs for inactivity in other disorders are being reported. The proportion of direct medical costs associated with physical inactivity in inactive US adults with arthritis was $1,250/patient, which is about 12.4% of direct costs, or about $8 billion/year (Wang et al., 2001).

Mortality costs:

Seven out of 10 deaths (1.6 million out of 2.3 million) in the US in 1996 were due to four chronic health conditions (total cardiovascular diseases, all cancers, chronic obstructive pulmonary disease, and diabetes). These 1.6 million deaths represented 24.3 million years lost, with an average of 14.8 years per death (Hoffman, Rice, & Sung, 1996). About 15% of the 1.6 million chronic health conditions were due to sedentary lifestyle alone.

Hahn et al. (1990) reported that 256,686 deaths in the USA were attributed to being either sedentary or irregularly physically active in 1986 (205,254 from coronary heart disease; 43,063 from stroke, and 8,369 from colon cancer; the effect of physical inactivity on other chronic conditions such as type 2 diabetes was not determined). The following information was used to confirm the 250,000 premature deaths from physical inactivity. A consensus statement read: ". . . physical activity expending 1000 kcal/wk (4200 kJ/wk) is associated with as much as a 30% reduction in all-cause mortality rates" (Kesaniemi et al., 2001). As there are approximately 706,000 deaths in the USA each year from coronary heart disease (459,841 deaths; American Heart

Association); type 2 diabetes (198,140 deaths; American Diabetes Association), and colon cancer (48,100 deaths; American Cancer Society) (see respective society web pages for sources) then 30% of the deaths for coronary heart disease, type 2 diabetes, and colon cancer (or 212,000 deaths) would be prevented by moderate-intensity physical activity that expended 1000 kcal/wk. The number of deaths from sedentary living is two times greater than that from microbial agents and also exceeds all deaths from firearms, illicit usage of drugs, sexually transmitted diseases, and motor vehicle accidents (McGinnis & Foege, 1993). Thus, a major cause of death in the US is sedentary living. In other words, the sedentary death syndrome (SeDS) comprises one of the top three causes of all-cause mortality in the US today, and directly contributes to the current second highest death rate in the country, which is obesity. Therefore, in the last 100 years, the leading causes of death have dramatically shifted from the scourges of infectious disease (in 1900), to tobacco, obesity, and SeDS (in 2000), which in essence constitute the new scourge for humanity. This is why the war against modern chronic diseases needs to be waged.

Are we winning the war against chronic health conditions?

Sadly, the answer is a resounding "No!" There has been a dramatic increase in the incidence of chronic health conditions in the latter part of the 20th century. Concurrent with this increase has been a reduction in the physical activity needed for daily sustenance. It is indeed a great irony that the disease consequences of physical inactivity, itself, are a negative by-product of the modern laborsaving devices that reduced the amount of physical activity needed to obtain the essentials for daily living and so free time to allow for the tremendous progress of the latter part of the 20th century.

Fighting the full battle: being proactive, instead of reactive

No one would deny that physicians and biomedical scientists have increased our understanding of the underlying pathophysiologic and therapeutic mechanisms of chronic disease at an impressive rate. From such phenomenal progress it is only natural for one to expect that medical research will cure all diseases and consequently, believe that it would be unnecessary to indulge in the practice of lifestyle behavior modification that would lower the incidence risk of such chronic maladies. Thus, the majority of our population must not be convinced enough that 30 minutes of moderate physical activity (e.g., brisk walking) each day is vital because of the entrenched belief that modern medicine will cure all ills. However, most biomedical advances for the treatment of chronic diseases are being concentrated *after* the disease is clinically observed and diagnosed. At best, such treatments stabilize the health condition, preventing further progression. As a rule, these treatments do not restore normal pre-disease function and health.

Therefore, we believe that a better therapeutic strategy would be to prevent pathology from ever occurring in the first place by maintaining physiologic homeostasis, and thereby limiting the progression of overt clinical disease. Research to cure diseases is definitely indispensable and should indeed be continued. However, a new emphasis on prevention should be recognized, now more than ever, especially in light of the burgeoning and powerful clinical epidemiological data.

Recently, it was shown that 82% of coronary heart disease (Stampfer, et al., 2000) and 91% of type 2 diabetes (Hu et al., 2001) is caused by high-risk lifestyles. Thus, the corollary by logical inference is that a large majority of such diseases are preventable by engaging in low-risk lifestyles. Low-risk behavior was defined as a combination of five variables: BMI of less than 25; a diet high in cereal fiber and polyunsaturated fat and low in trans fat and glycemic load (which reflects the effect of diet on the blood glucose level); engagement in moderate-to-vigorous physical activity for at least half an hour per day; no current smoking; and the consumption of an average of at least half a drink of an alcoholic beverage per day (Hu et al., 2001). Thus, physical activity forms a vital component of our defense arsenal in the prevention of coronary heart disease and type 2 diabetes. Hence, we propose that the fight against chronic health conditions can be made more effective by expanding our biomedical research efforts into the little explored (and even less supported) battlefield of primary prevention by being proactive.

Flushing out the silent enemy: primary prevention of chronic health conditions.

As we emphasized in a previous review (Booth et al., 2000), the treatment of the symptoms and not the cause, or to treat the cause *after* it precipitates the clinically overt disease, may not be the wisest strategy as it will cost more money, lower the quality of life, and accentuate human suffering. Conversely, primary prevention is unusual as a "medicine" in that it is implemented *before* a chronic health condition is clinically manifested. That is, a chronic health condition may never reach its pathologic threshold to compromise the health of an individual if it is attacked at its origin to delay and/or prevent its progression. Preventing a chronic health condition in the first place is more humane and produces less suffering than secondary or tertiary treatment of full-blown overt disease. In other words, the practice of primary prevention is a fundamental demonstration of the very essence of the Hippocratic oath: "first, do no harm." It is indeed ironic that practicing primary prevention is considered basic common sense in other inanimate aspects of our daily life, when we neglect to do the same when it comes to our own personal health, a most fragile entity. For example, is it not less damaging and expensive for an automobile to undergo routine maintenance such as oil changes rather than to undergo a complete engine replacement after several years of neglect? Moreover,

primary prevention has even been used successfully against acute diseases. Smallpox, polio, and other infectious diseases have been virtually eliminated through the use of primary prevention methods (i.e., vaccination). If primary prevention has been successfully employed in the war against these other diseases, why not use this strategy against modern chronic disease?

Weapons to combat sedentary-induced diseases

The weapon of a strong case against inactivity-related disorders: Cost can be used as a weapon to fight for a change to a more physically active society. For example, Colditz (1999) suggested that focused strategies to increase the level of physical activity will likely produce substantial benefits through reduced health care costs as well as through reduction in indirect costs and gains in quality of life. One crucial target for potential reductions in health care cost would be to eliminate physical inactivity by replacing it with moderate-intensity activity for the 70% of the US population who now are at high risk for SeDS. However, this weapon has not been widely employed. Fries et al. (1993) wrote: "Advocates of health promotion have themselves caused delays, first by not making cost reduction a primary goal, and second by neglecting rigorous economic evaluation." It is our belief that there now exists sufficient and rather convincing cost-of-illness data (a minimum of $150 billion in the annual direct and indirect costs for physical inactivity, Pratt, Macera & Wang, 2000) to demand immediate cost effectiveness studies to rationally justify the promotion of moderate-intensity physical activity to reduce health care expenditures. We believe that this is a weapon to force policies for the reinsertion of physical activity into daily life in order to lessen the unnecessary human suffering from chronic health conditions.

The weapon of activism and advocacy: Professionals associated with physical activity in their occupations must become greater advocates to facilitate the incorporation of physical activity as a part of daily living. A few examples that can be initiated in specific age groups include:

- Children and adolescents: Promotion of 60 min of daily physical activity by: 1) school recesses, 2) lifetime physical activity in physical education classes, 3) teaching in schools of the biological and medical basis by which physical inactivity increases the risk of chronic health conditions, 4) training students how to count calories from walking and climbing stairs, 5) teaching and encouraging healthy nutrition habits by minimizing junk foods in school cafeterias, 6) recreational sports for those students whose skills do not allow them to compete on interscholastic athletic teams, and 7) encourage children and youth to engage in 60 minutes of physical activity daily for six weeks to qualify for the Presidential Active Lifestyle Award (PCPFS, 2001). Communities should be made to be friendly and safe for children to be physically active by providing safe paths to walk or cycle to school, and by the opening of school gyms for after-hours physical activities.
- Adults: Family play and outings should be promoted by providing neighborhood sidewalks, safe parks in urban areas, school gyms, and community recreational buildings. Adults should be encouraged to undertake a minimum of 30 minutes of physical activity each day by their employers, as part of their "health coverage benefits." Legislators, corporate heads, and community leaders should be lobbied to support a physically active America.
- Seniors: Promotion of a physically active lifestyle should occur through the inclusion of physical activity at social gatherings. Seniors should be allowed free access to strength training equipment, recreational facilities, and educated on the consequences of a sedentary lifestyle on their vitality, quality of life, and ability to perform the tasks of daily living.

In a similar vein, another class of weapons is dissemination of information to the general public via various formats and media. Providing greater awareness and educating the general public about the existence of the large body of scientific evidence supporting the many positive benefits of a physically active lifestyle in promoting good health (Chakravarthy, Joyner, and Booth, 2002) not only broadens our understanding of the underlying problem, but it also empowers us to become proactive in our own ways to lead a healthier lifestyle. Such active individual involvement would indeed be a potent weapon to bring about a fundamental shift in our thinking as we begin to redirect our focus towards winning the ongoing war on modern chronic diseases.

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How to become a soldier in the war against physical inactivity-induced chronic health conditions

Each person reading this article is urged to become a foot soldier in his or her own community, advocating the inclusion of appropriate physical activity for health. Many organizations exist to promote physical activity. A foot soldier should advocate that these organizations become more proactive in presenting the facts in this review to those decision makers who in turn can make policies to facilitate a more physically active lifestyle, and thereby play a direct part in facilitating a healthier and more prosperous America. Further information can be obtained from the website http://www.endseds.org.

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References

Allison, D. B., Fontaine, K. R., Manson, J. E., Stevens, J., & VanItallie, T. B. (1999). Annual deaths attributable to obesity in the United States. *JAMA 282*, 1530-1538.

American Diabetes Association. (2001). Diabetes 2001: *Vital Statistics*. Alexandria, VA: American Diabetes Association.

American Heart Association. (1998). *1999 Heart and Stroke Statistical Update*. Dallas, TX: American Heart Association.

American Heart Association. (2000). *2001 Heart and Stroke Statistical Update*. Dallas, TX: American Heart Association.

Booth, F. W., Gordon, S. E., Carlson, C. J., & Hamilton, M. T. (2000). Waging war on modern chronic diseases: primary prevention through exercise biology. *J. Appl. Physiol. 88*, 774-787.

Boyle, J. P., Honeycutt, A. A., Narayan, K. M., Hoerger, T. J., Geiss, L. S., Chen, H., & Thompson, T. J. (2001). Projection of Diabetes Burden Through 2050: Impact of changing demography and disease prevalence in the U.S. *Diabetes Care 24*, 1936-1940.

Campion, E. W. The oldest old. (1994). *N. Engl. J. Med. 330*, 1819-1820.

Chakravarthy, M. V., Joyner, M. J., and Booth, F. W. An obligation for primary care physicians to prescribe physical activity to sedentary patients to reduce the risk of chronic health conditions. (2002). *Mayo Clinic Proc.* 77: February issue.

Colditz, G. A. (1999). Economic costs of obesity and inactivity. *Med. Sci. Sports Exerc. 31*, Suppl S663-S667.

Dorland's Illustrated Medical Dictionary (25th ed.). (1974). Philadelphia, PA: Saunders.

Flegal, K. M., Carrol, M. D., Kuczmarski, R. J., & Johnson, C. L. (1998). Overweight and obesity in the United States: prevalence and trends, 1960-1994. *Int. J. Obesity 22*, 39-47.

Fries, J. F., Koop, C. E., Beadle, C. E., Cooper, P. P., Endland, M. J., Greaves, R. F., Sokolov, J. J., Wright, D., & the Health Project Consortium. (1993). Reducing health care costs by reducing the need and demand for medical services. *New Engl. J. Med. 329*, 321-325.

Hahn, R. A., Teutsch, S. M., Rothenberg, R. B., & Marks, J. S. (1990). Excess deaths from nine chronic diseases in the United States, 1986. *JAMA 264*, 2654-2659.

Harris, M. I. & Eastman, R. C. (2000). Early detection of undiagnosed diabetes mellitus: a US perspective. *Diabetes Metab. Res. Rev. 16*, 230-236.

Hoffman, C., Rice, D., & Sung, H. Y. (1996). Persons with chronic conditions. Their prevalence and costs. *JAMA 276*, 1473-1479.

Hu, F. B., Manson, J. E., Stampfer, M. J., Colditz, G., Liu, S., Solomon, C. G., & Willett, W. C. (2001). Diet, lifestyle, and the risk of type 2 diabetes mellitus in women. *N. Engl. J. Med.* 345, 790-797.

Hu, F. B., Sigal, R. J., Rich-Edwards, J. W., Colditz, G. A., Solomon, C. G., Willett, W. C., Speizer, F. E., & Manson, J. E. (1999). Walking compared with vigorous physical activity and risk of type 2 diabetes in women: a prospective study. *JAMA 282*, 1433-1439.

Hu, F. B., Stampfer, M. J., Colditz, G. A., Ascherio, A., Rexrode, K. M., Willett, W. C., & Manson, J. E. (2000). Physical activity and risk of stroke in women. *JAMA 283*, 2961-2967.

Jung, R. T. (1997). Obesity as a disease. *Br. Med. Bull. 53*, 307-321.

Kesaniemi, Y. K., Danforth, E. Jr., Jensen, M. D., Kopelman, P. G., Lefebvre, P., & Reeder, B. A. (2001). Dose-response issues concerning physical activity and health: an evidence-based symposium. *Med. Sci. Sports Exerc. 33(6 Suppl)*, S351-S358.

Koplan, J. P. & Dietz, W. H. (1999). Caloric imbalance and public health policy. *JAMA 282*, 1579-1581.

Libman, I. & Arslanian, S. A. (1999). Type 2 diabetes mellitus: no longer just adults. *Pediatr. Ann. 28*, 589-593.

Manson, J. E., Hu, F. B., Rich-Edwards, J. W., Colditz, G. A., Stampfer, M. J., Willett, W. C., Speizer, F. E., & Hennekens, C. H. (1999). A prospective study of walking as compared with vigorous exercise in the prevention of coronary heart disease in women. *N. Engl. J. Med. 341*, 650-658.

McGinnis, J. M. & Foege, W. H. (1993). Actual causes of death in the United States. *JAMA 270*, 2207-2212.

Mokdad, A. H., Bowman, B. A., Ford, E. S., Vinicor, F., Marks, J. S., & Koplan, J. P. (2001). The continuing epidemics of obesity and diabetes in the United States. *JAMA 286*, 1195-1200.

Mokdad, A. H., Serdula, M. K., Dietz, W. H., Bowman, B. A., Marks, J. S., & Koplan, J. P. (1999). The spread of the obesity epidemic in the United States, 1991-1998. *JAMA 282*, 1519-1522.

Must, A., Spadano, J., Coakley, E. H., Field, A. E., Colditz, G., & Dietz, W. H. (1999). The disease burden associated with overweight and obesity. *JAMA 282*, 1523-1529.

Pate, R. R., Pratt, M., Blair, S. N., Haskell, W. L., Macera, C. A., Bouchard, C., Buchner, D., Ettinger, W., Heath, G. W., King, A. C., et al. (1995). Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA 273*, 402-407.

Pinhas-Hamiel, O., Dolan, L. M., Daniels, S. R., Standiford, D., Khoury, P. R., & Zeitler, P. (1996). Increased incidence of non-insulin-dependent diabetes mellitus among adolescents. *J. Pediatr. 128*, 608-615.

Pratt, M., Macera, C. A., & Wang, G. (2000). Higher direct medical costs associated with physical inactivity. *The Physician and Sportsmedicine 28*, 63-70, 2000.

President's Council on Physical Fitness and Sports (2001). *The President's Challenge Physical Activity and Fitness Awards Program*. Washington, DC: PCPFS.

Random House Webster's Unabridged Dictionary, 2nd Ed. Random House: New York, 1997.

Stampfer, M. J., Hu, F. B., Manson, J. E., Rimm, E. B., & Willett, W. C. (2000). Primary prevention of coronary heart disease in women through diet and lifestyle. *N. Engl. J. Med. 343*, 16-22.

Stedman's Medical Dictionary, 27th edition (2000). Baltimore: Lippincott Williams & Wilkins.

Troiano, R. P. & Flegal, K. M. (1998). Overweight children and adolescents: description, epidemiology, and demographics. *Pediatrics 101*, Suppl.: 497-504.

USDHHS (1996). Surgeon General's report on physical activity and health. (1996). From the Centers for Disease Control and Prevention. Washington, DC: US Government Printing Office.

Wang, G., Helmick, C. G., Macera, C., Zhang, P., & Pratt, M. (2001). Inactivity-associated medical costs among US adults with arthritis. *Arthritis Rheum. Arthritis Care Res. 45*, 439-45.

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